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(54) Dish-washing machines.

(57) A dish washing machine is provided with heated independent reservoirs for heating rinse water and wash water. Each reservoir is provided with its own thermostat (1, 2). The heaters (10a-c, 13a-c) are prevented from operating simultaneously to minimise the overall power rating of the machine. Priority is given to heating the rinse water to ensure that the rinse water is sufficiently hot when used. This is arranged by controlling the power supply to the wash water heater (10a-c) in response to operation of the thermostat (2) of the rinse water reservoir. In order to ensure that a machine cycle does not commence until the wash water is at the required temperature, the power supply (24) to a machine operation timer (22) is controlled by the thermostat (1) of the wash water reservoir.

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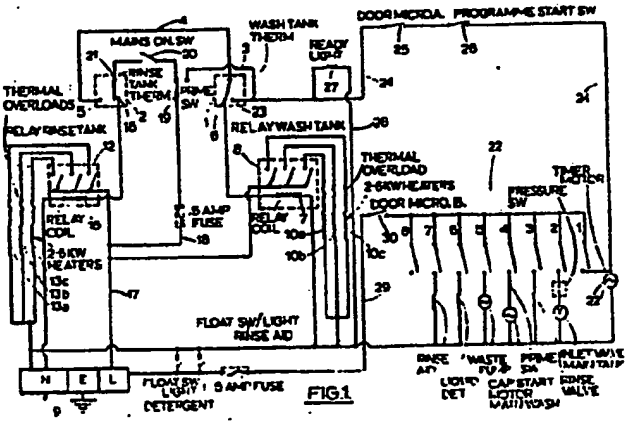
MAINS ON SW
WASH TANK THERM
READY LIGHT
DOOR MICRO A
PROGRAMME START SW
THERMAL OVERLOADS
RINSE TANK THERM
PRIME SW
RELAY RINSE TANK
RELAY WASH TANK
THERMAL OVERLOAD
2-6KW HEATERS
DOOR MICRO B
PRESSURE SW
TIMER MOTOR
RELAY COIL
5 AMP FUSE
2-5 KW HEATERS
FLOAT SW/LIGHT RINSE AID
FLOAT SW LIGHT
5 AMP FUSE
DETERGENT
RINSE AID
WASTE PUMP
PRIME SW
INLET VALVE MAIN WASH
CAP START MOTOR
MAIN WASH SW
RINSE VALVE
N
E
L

FIG.1

DISH-WASHING MACHINES

This invention relates to so-called dish-washing machines which may of course be used for washing bottles, glasses, cutlery and similar articles. The invention relates to machines of the batch type as opposed to the continuous process flight type of machine.

In a machine of the batch type a batch of articles is subjected in a washing chamber to a washing and rinsing cycle, and the cycle is repeated on the next batch of articles. With such machines the articles may be inserted into the washing chamber through a door opening, or in some machines a washing cabinet is lowered over a rack load of articles.

The invention is particularly applicable to commercial dish-washing machines as used by restaurants, and by hospitals for washing instruments prior to sterilisation, but may also be incorporated in domestic dishwashers.

Many commercial dish-washers employ a heated bath for washing water and a separate heated reservoir for rinse water. During rinsing the rinse water after being sprayed onto the dishes falls into the bath of washing water, which overflows to an outlet, but the water remaining in the bath at the end of the rinsing is used as the wash water for the next batch of dishes. Although it may be intended that the washing water in the bath be changed after a few batches of dishes, this often will not be done sufficiently frequently in a busy restaurant, and an accumulation of bacteria and solids can result.

Although commercial machines are sometimes provided with a light which indicates when the wash water and rinse water temperatures have reached desired levels, this light is often disregarded by the operator who initiates a washing/rinse cycle before the water is hot enough to provide adequate cleaning.

With many domestic dishwashers it has been usual to provide fresh water for each stage of the cycle selected by the user. For each such stage the fresh water is brought into the wash chamber where it is then heated to the requisite temperature before use, and then taken to waste before the next charge of water is brought in to be heated for the next stage.

It is generally accepted that the standards of cleanliness and bacterial control achieved in a domestic dishwasher are superior to those of a commercial dishwasher, by virtue of properly controlled water temperatures and correct detergent concentrations, coupled with the use of fresh water for each stage.

As it is normal practice with most domestic dishwashers to offer alternative programme sequences, with each stage requiring fresh water in all but the drying stage if such is provided, the programme time is extremely long and hence unsuitable for commercial use.

A typical domestic dishwasher offers an optional heated or unheated pre-rinse, an obligatory wash and subsequent rinse, followed by optional additional heated and/or unheated rinses and an optional heated drying stage. The minimum programme time for these dishwashers may be 45 minutes and the longest may be over 100 minutes.

Summarising, commercial dishwashers may be said to be designed to risk jeopardising washing performance and hygiene standards in the interests of achieving short cycle times, whereas domestic dishwashers may be said to be designed to achieve a high standard of washing performance and hygiene at the expense of time taken.

A compromise design of machine was proposed in U.K. Patent Specification No. 901 475 the machine employing a single heated reservoir, separate from the wash chamber, that was used to pre-heat firstly the wash water, and subsequently the rinse water for one or more rinses.

This design of machine could provide the consistently higher standards of washing performance and hygiene normally found in domestic dishwashers, with a substantially shorter time cycle than previously known domestic dishwashers.

This design of machine was also considered suitable for commercial applications in cases where the shortest possible time cycle was not of paramount importance, or where the need for consistent washing performance and hygiene was recognised.

With that machine the water for rinsing a batch of dishes was heated in the reservoir during washing of the batch, and rinsing ensued as soon as washing was completed as determined by a timer, irrespective of the temperature that had been reached by the rinse water.

It was therefore inherent in the design that the programme times would become longer if the rinse water was to be pre-heated to a suitable temperature for hygiene purposes, or alternatively that in the interests of shorter time that the rinse water temperature might not be at the requisite level.

We consider it important for a commercial dishwasher that consistently acceptable levels of wash and rinse performance are assured in the interests of health and hygiene, and that the batch time for washing and rinsing a batch of articles, that is the time between loading a batch into the machine and it being ready for removal, should be as short as possible consistent with these requirements.

We contend that to achieve acceptable levels of wash performance and hygiene it is necessary to use fresh water at the requisite temperature for each wash, and to use further fresh water at the requisite temperature for subsequent rinsing.

With regard to domestic dishwashers, we consider it to be advantageous for the time cycle to be substantially reduced without detriment to the standards of washing performance or hygiene that they already provide.

We consider it important that a machine should have a known batch time which is as short as possible. The user then knows precisely how long it will be before the articles are ready for re-use.

The present invention stems from attempts to provide a machine which has a predetermined batch time, yet which uses fresh water at a predetermined temperature/temperatures for both washing and rinsing.

According to the invention a dish-washing machine comprises first and second heated reservoirs for providing hot water for washing and rinsing respectively, each reservoir comprising a respective inlet for connection to a water supply and a respective outlet con-

nected to washing means and rinsing means respectively, and a respective valve controlling water flow from the respective inlet to the respective outlet, the heaters of the reservoirs being controlled by respective thermostats set to provide hot water at a predetermined temperature/ temperatures, and means for substantially draining washing water and rinse water from the washing chamber for each cycle of washing and rinsing.

The same or different predetermined temperatures may be chosen for the first and second reservoirs, and if desired means may be provided to enable adjustment of the predetermined temperature.

Preferably the arrangement is such that the heaters for the first and second reservoirs are prevented from being switched on simultaneously, in order to reduce the overall power rating of the machine.

It is preferably then arranged that priority is always given to heating the rinse water in the second reservoir. This ensures that as soon as the washing part of the cycle has finished, as determined by a timer, hot water at the desired temperature is immediately available for the rinsing part of the cycle. Also, if the water in the rinse reservoir cools during the washing part of the cycle, the associated thermostat will operate to switch on the rinse water heater to bring the rinse water back up to the predetermined temperature. The rinse water heater will come on at this stage even though the wash water heater was in operation, the wash water heater automatically being switched off whilst the rinse water heater is on, but being switched on again as soon as the rinse water has been made sufficiently hot.

The priority arrangement is conveniently achieved by arranging the thermostat of the second reservoir to operate a two-way switch when the predetermined temperature of that reservoir is reached, to feed control current for the heater of the first reservoir to a switch controlled by the thermostat of the first reservoir.

Preferably the arrangement is such that initiation of a washing/rinse cycle is prevented until the water in both the first and second reservoirs has reached the predetermined temperature/temperatures. This ensures that a washing/rinse cycle can be performed in a prescribed time at the selected temperature/ temperatures.

Conveniently this is arranged by connecting a switch operated by the thermostat of the first reservoir into the power supply of the timer which controls initiation of the wash/rinse cycle.

Preferably said switch operated by the thermostat of the first reservoir is a two-way switch which in one condition energises the heater of the first reservoir, providing that the heater of the second reservoir is not energised, and in its other condition when the temperature of the first reservoir exceeds its predetermined temperature provides a starting current to the timer.

Preferably each heater comprises a plurality of individual heater elements connected in parallel. When the available power is restricted it is then possible to disconnect one or more elements without affecting the batch time, although the warm-up time will of course be affected.

A dishwasher in accordance with the invention will now be described, by way of example only, with reference to the accompanying drawings in which:-

Figure 1 is a circuit diagram of the dish-washer; and

Figure 2 is a chart showing the timing sequence of the timer employed with the circuit of Figure 1.

The construction of the dishwasher is not shown in the drawings. It comprises a cabinet in which is defined a washing chamber into which a rack stacked with dishes etc. may be inserted through a hinged door. A pair of spray heads is provided for spraying washing water and rinse water respectively onto the dishes. First and second water reservoirs are provided, each water reservoir comprising a sealed water vessel provided at its lower end with an inlet for connection via a respective solenoid-controlled inlet valve to a water supply, which may be hot or cold, and at its upper end with an outlet. The outlet in the case of the first reservoir leads to a storage tank mounted below the washing chamber into which drains water sprayed onto the dishes, and which feeds a pump connected to the washing spray head. The outlet of the second reservoir is connected directly to the rinsing spray head.

Each reservoir is provided with a respective electrical heater and with a thermostat responsive to the water temperature in the reservoir. With reference to Figure 1, the thermostats operate respective single-pole double-throw or two-way switches 1, 2. Wash reservoir thermostat switch 1 has a contact 3 connected by lead 4 to a contact 5 of rinse reservoir thermostat switch 2, a contact 6 connected through the coil 7 of a wash reser-

voir relay 8 to the neutral contact N of a mains input 9.

Wash reservoir relay 8 has three switch arms to provide independent current paths to separate heating elements 10a, 10b, 10c which comprise the heater of the wash water reservoir. The use of separate switch arms and independent wiring for the different heating elements enables a relatively high capacity heater to be provided.

An identical relay 12 is provided for the heater of the rinse reservoir, and this controls the power supplies to the heating elements 13a, 13b, 13c which comprise the heater of the rinse reservoir.

The coil 15 of the rinse reservoir relay 12 is connected between the N contact of the mains supply 9 and a contact 16 of the rinse thermostat switch 2. The live feed to contact 21 of the rinse thermostat switch 2 is by way of leads 17, 18, a PRIME switch 19, and a MAINS 'ON' light and switch 20, the functions of which will be explained.

The switch arm of the rinse thermostat 2 is shown in the position it occupies when the temperature of the water in the rinse reservoir is below the predetermined temperature at which the thermostat is set to operate. That predetermined temperature may be preset or manually adjustable if desired. In that position of the switch arm, and assuming that switches 19 and 20 are on, the coil 15 of rinse relay 12 is energised to energise heating elements 13a, 13b, 13c of the rinse water reservoir heater. The live feed to contact 3 of the wash reservoir thermostat 1 is from contact 5 of thermostat 2 and is thus available only when the switch

arm of thermostat 2 switches to connect contacts 21 and 5, when the temperature of the water in the rinse reservoir exceeds the predetermined temperature of thermostat 2.

This arrangement ensures that only one of the heaters is on at any one time, and moreover that priority is given to heating the water in the rinse reservoir over heating water in the wash reservoir.

The switch arm of wash thermostat 1 is shown in the position is occupies when the water in the wash water reservoir is below the predetermined temperature to which that thermostat has been set, in which position contact 3 is connected to contact 6 so as to energise coil 7 providing that contact 3 has been rendered live by thermostat 2.

The predetermined temperature of thermostat 1 may be made different from that of thermostat 2 if desired.

Since only one heater is operative at any time the maximum power consumption of the machine is approximately half what it otherwise would be. This enables the use of heaters of maximum capacity commensurate with the rating of the mains supply 9. This is important because it enables the time between washing batches of dishes to be kept to a minimum.

A conventional timer assembly 22 controls the sequence of the wash and rinse cycle, the assembly comprising a constant speed timer motor 22' driving a shaft provided with a series of cam-operated switches numbered 1 to 8 in the representation of the timer 22 in Figure 1. The live feed to the motor 22' of timer 22 is from a contact 23 of the wash water thermostat 1 by way

of lead 24, a first door switch 25 and a program start/light switch 26, and since contact 23 is not live until the switch arm of wash water thermostat 1 switches from the position shown, the timer motor does not begin to run until the thermostat 1 switches when the predetermined temperature of the water in the wash water reservoir has been reached.

Since priority is given to heating water in the rinse water reservoir, the contact 23 will not be made live until water in both the rinse water reservoir and wash water reservoir has been brought up to the appropriate predetermined temperature, and thus the washing cycle cannot commence until this condition has been reached.

When contact 23 becomes live this is indicated to the user by a ready-light 27 which is connected between lead 24 and the N contact by lead 28. A further live feed to timer 22 is by way of lead 29 and a second door operated switch 30, this feed supplying the cam-operated switches 1 to 8 of the timer assembly.

The sequencing of the timer assembly 22 is shown in Figure 2. Contact 1 is a self-energising contact for the timer motor 22' which ensures that the motor once started is held energised throughout the wash/rinse cycle despite the fact that contact 23 will go dead during the cycle due to energisation of a reservoir heater. Contact 1 is arranged to be dead for only a few degrees of the 360° of the cam, the motor speed in this case providing one revolution of the cam in 5 minutes, the wash/rinse cycle time in this case.

Contacts 2 and 3 provide energisation respectively for the solenoid-operated inlet valves of the wash water

reservoir and rinse water reservoir. Contact 4 provides energisation for the pump which pumps water from the storage tank to the washing spray head. Contact 5 provides energisation for a waste pump which is arranged to pump water from the storage tank to a waste outlet when the storage tank is to be emptied. Contact 6 provides energisation for a liquid detergent dispenser which dispenses into the storage tank, and contact 7 provides energisation for a rinse aid. (Contact 8 is unused.)

The operation of the dish washer will now be described.

When the machine is first commissioned the prime switch 19 is switched from the condition shown in Figure 1 to ensure that a full cycle of operation of the machine is carried out before the heaters can be operated, in order to ensure that the water reservoirs are filled. In normal use, when the machine is switched on from cold, the timer motor 22' will be switched off, having been de-energised in the previous cycle by timer contact 1 at a position just short of 360°. When the operator puts on the mains-on switch 20 the rinse water relay 12 will be energised by rinse thermostat 2 to energise the heating elements 13a, 13b, 13c of the rinse water reservoir. When the predetermined temperature of the rinse water has been reached thermostat 2 switches to energise contact 3 of thermostat 1, relay 12 is deenergised and relay 8 is energised to energise elements 10a, 10b, 10c. When the wash water in the wash water reservoir has reached the required temperature, the thermostat switch 1 will switch to deenergise the relay 8 and energise contact 23 to bring on ready-light 27.

When the operator closes the machine door after loading the dishes into the washing chamber, switches 25 and 30 are closed. The operator then operates the program start/light switch 26 which provides initial energisation of the timer motor 22'. When the cam shaft of assembly 22 reaches 360° the motor holding contact 1 is energised, along with the contacts 2 and 4 which open the inlet valve to the wash water reservoir and operate the main pump respectively. on opening of the inlet valve hot water in the wash water reservoir is driven by supply water into the storage tank. The inlet valve is closed when a pressure switch senses that a prescribed water level has been reached in the storage tank. The main pump pumps this water from the storage tank to the wash water spray head onto the dishes, the wash water draining back into the storage tank.

Suitable filters may be provided to filter solids from this circulating water.

Shortly after commencement of the main pump a charge of liquid detergent is dispensed into the storage tank through energisation of timer contact 6.

As soon as the hot water has been expelled from the wash-water reservoir, the thermostat 1 will switch to energise the relay 8 to begin heating of the wash water for the next batch of dishes. It is to be noted that this heating of the wash water can take place substantially during the washing cycle of the machine so that there is a minimum delay between completion of one washing/rinse cycle and the machine being ready to deal with a further batch of dishes. The precise heating time for the wash water will, of course, depend upon the temperature of the water supply.

The rinse water is not required until a 320° setting of the cam shaft. Initially the rinse water is at the desired temperature for use, but if in the meantime the temperature of the water in the rinse water reservoir falls sufficiently to operate thermostat switch 2, the heating elements 13a, 13b, 13c will be re-energised to bring the rinse water back up to the predetermined temperature. It is to be noted that this will occur despite the fact that the water in the wash water reservoir may not yet have been fully heated, due to the priority wiring arrangement to the thermostat 2. This ensures that the rinse water is at an adequate temperature when it is required, yet maximum use is made of the available time for heating the wash water for the next machine cycle, the heaters switching on alternately as required with priority given to the rinse water.

At 318° of the timer 22 the timer contact 4 is deenergised to stop the main pump, and at 320° timer contacts 3, 5 and 7 are energised to open the inlet valve to the rinse water reservoir, energise the waste pump and rinse aid respectively. Hot water is expelled from the rinse water reservoir by supply water, which may again be hot or cold, and the hot rinse water is forced through the rinse water spray head to rinse the dishes. The use of a separate spray head reduces the chances of bacterial contamination. Meanwhile the waste pump is operating to pump water from the storage tank to the waste outlet. At 350° of the timer 22 the rinse water inlet vavle is closed and the waste pump is deenergised, and shortly afterwards the timer motor 22' is deenergised by contact 1 to complete the cycle. The dishes may then be removed from the machine.

As soon as the hot water has been expelled from the rinse water reservoir thermostat 2 will operate to

commence heating of the rinse water in readiness for the next batch of dishes, so that whilst the machine is being unloaded and reloaded heating of the rinse water is taking place, in order to reduce the wash/rinse cycle time.

It will be noted that with the machine described the wash and rinse water is changed for each cycle of the machine.

One advantage of the machine described is that the number of heating elements employed in each heater may be altered to suit the available mains supply but this will not affect the wash/rinse cycle time, although if only one or two heating elements were to be used there would be an increased delay between the end of one cycle and the machine being ready for the next cycle.

CLAIMS

1. A dish-washing machine comprising heating means (10a-c, 13a-c) for providing hot water for washing and rinsing in a washing chamber, a washing means and a rinsing means, and draining means for draining water from the washing chamber, characterised in that the heating means comprises first and second heated reservoirs for respectively heating wash water and rinse water, each reservoir comprising a respective inlet for connection to a water supply and a respective outlet connected to the washing means and rinsing means respectively, and a respective valve controlling water flow from the respective inlet to the respective outlet, the heaters (10a-c, 13a-c) of the reservoirs being controlled by respective thermostats (1, 2) set to provide hot water at a predetermined temperature/temperatures, and in that the draining means is arranged to drain substantially completely washing water and rinse water from the washing chamber for each cycle of washing and rinsing.

2. A machine as claimed in claim 1 in which the arrangement is such that the heaters for the first and second reservoirs are prevented from being switched on simultaneously.

3. A machine as claimed in claim 2 and comprising priority switching means (5, 16, 21) arranged to provide priority to heating the rinse water in the second reservoir over heating wash water in the first reservoir.

4. A machine as claimed in claim 3 in which the priority switching means comprises a two-way switch (5, 16, 21) controlling the power supply to the heater (10a-c) of the first reservoir, the thermostat (2) of the second reservoir being arranged to operate the

two-way switch to permit power to be supplied to the heater of the first reservoir when the water of the second reservoir is sufficiently hot to operate the thermostat of the second reservoir.

5. A machine as claimed in any of the preceding claims comprising inhibit means preventing initiation of a washing/rinse cycle until the water in both the first and second reservoirs has reached the predetermined temperature/temperatures.

6. A machine as claimed in claim 5 in which the inhibit means comprises a switch (3, 6, 23) operated by the thermostat (1) of the first reservoir and controlling the power supply (24) to a timer (22) which controls initiation of the wash/rinse cycle.

7. A machine as claimed in claim 6 as appended to claim 4 in which said switch (3, 6, 23) operated by the thermostat of the first reservoir is a two-way switch which in one condition energises the heater (10a-c) of the first reservoir, providing that the heater (13a-c) of the second reservoir is not energised, and in its other condition when the temperature of the first reservoir exceeds its predetermined temperature provides a starting current to the timer.

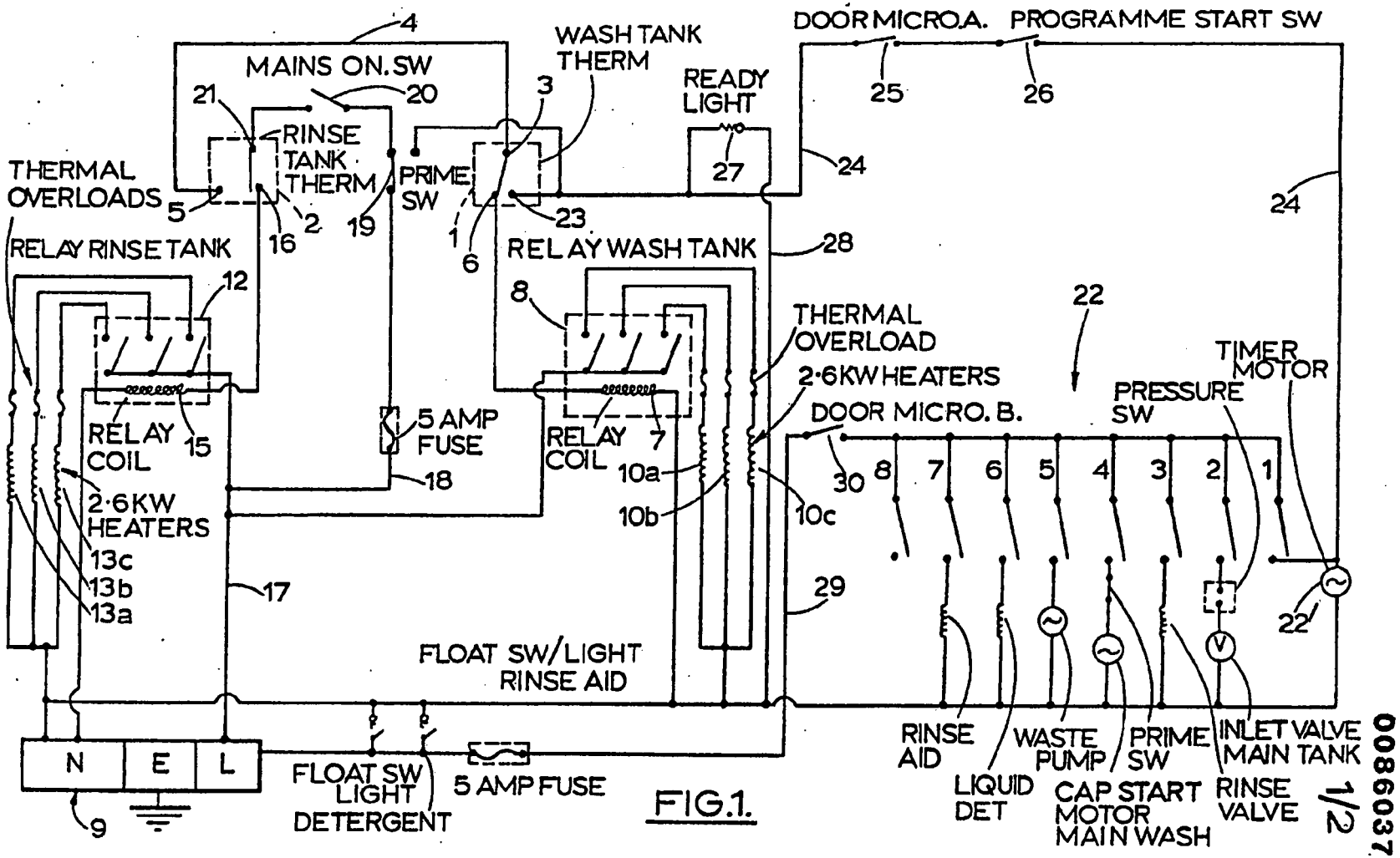

FIG.1.

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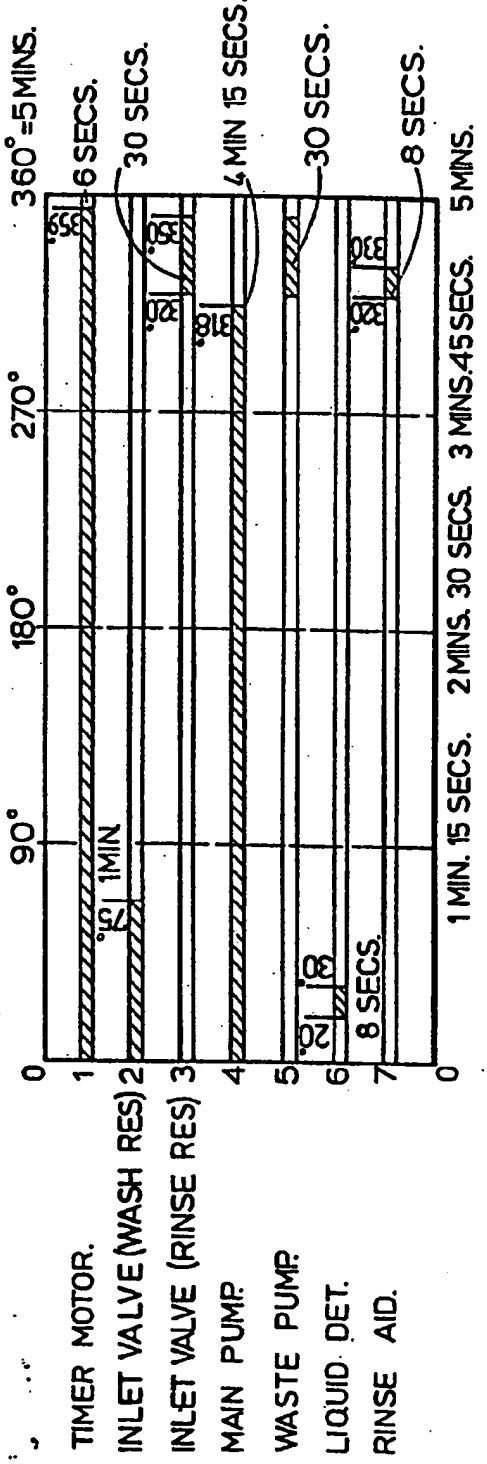
0
90°
180°
270°
360°=5 MINS.
TIMER MOTOR.
INLET VALVE (WASH RES)
INLET VALVE (RINSE RES)
MAIN PUMP
WASTE PUMP
LIQUID DET.
RINSE AID.
1 MIN
6 SECS.
30 SECS.
4 MIN 15 SECS.
30 SECS.
8 SECS.
8 SECS.
1 MIN. 15 SECS.
2 MINS. 30 SECS.
3 MINS. 45 SECS.
5 MINS.
SEQUENCE

FIG 2.

European Patent Office

EUROPEAN SEARCH REPORT

0086037
Application number

EP 83 30 0145

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
A	GB-A-1 092 190 (ESSO) * Figure 2 *	1	A 47 L 15/46
A	US-A-4 254 788 (HELWIG) * Claim 1 *	1	
P,A	US-A-4 331 484 (HELWIG) * Claim 1 *	1	
D,A	GB-A- 901 475 (BULPITT & SONS)		

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

A 47 L 15/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	30-03-1983	KLITSCH G

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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E : earlier patent document, but published on, or after the filing date
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